



# Energy, CO<sub>2</sub>,

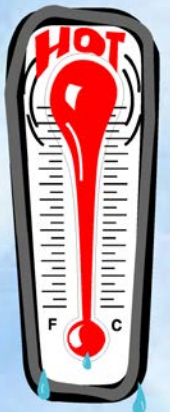
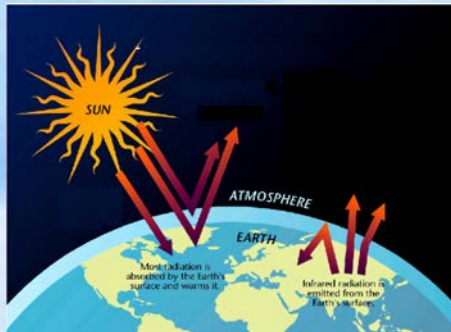
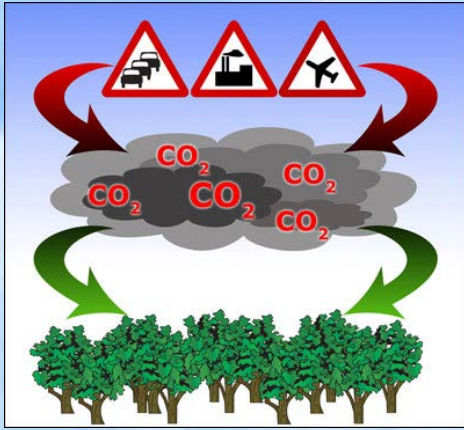
# Climate, and YOU!

## Stephen E. Schwartz

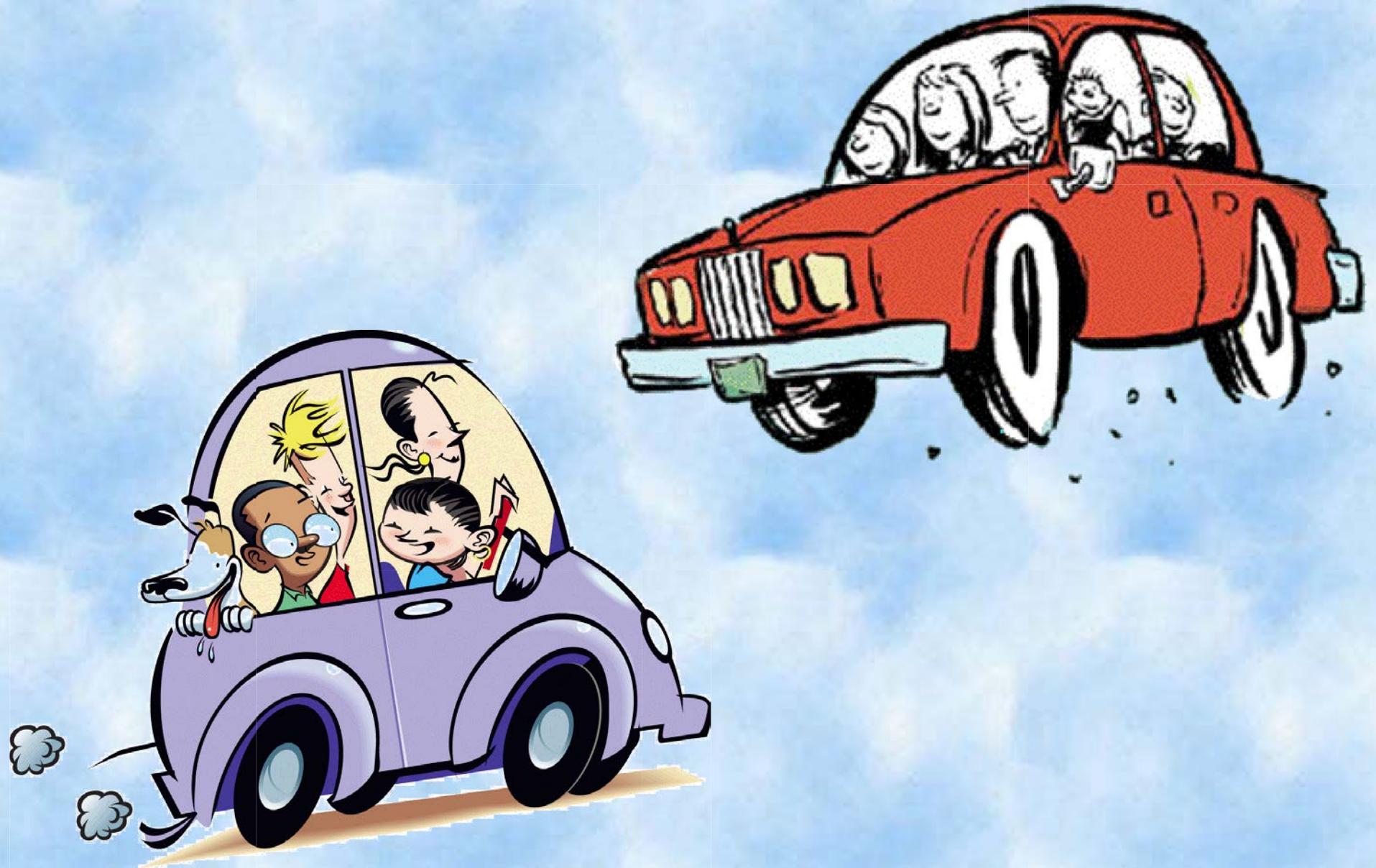
**BROOKHAVEN**  
NATIONAL LABORATORY

summer  sundays

[www.ecd.bnl.gov/steve](http://www.ecd.bnl.gov/steve)



# CARPOOLING TO SUMMER SUNDAY AT BNL





THE MOST EFFECTIVE WAY TO  
DOUBLE THE FUEL ECONOMY  
OF A CAR . . .

***IS TO PUT TWO  
PEOPLE IN IT!***

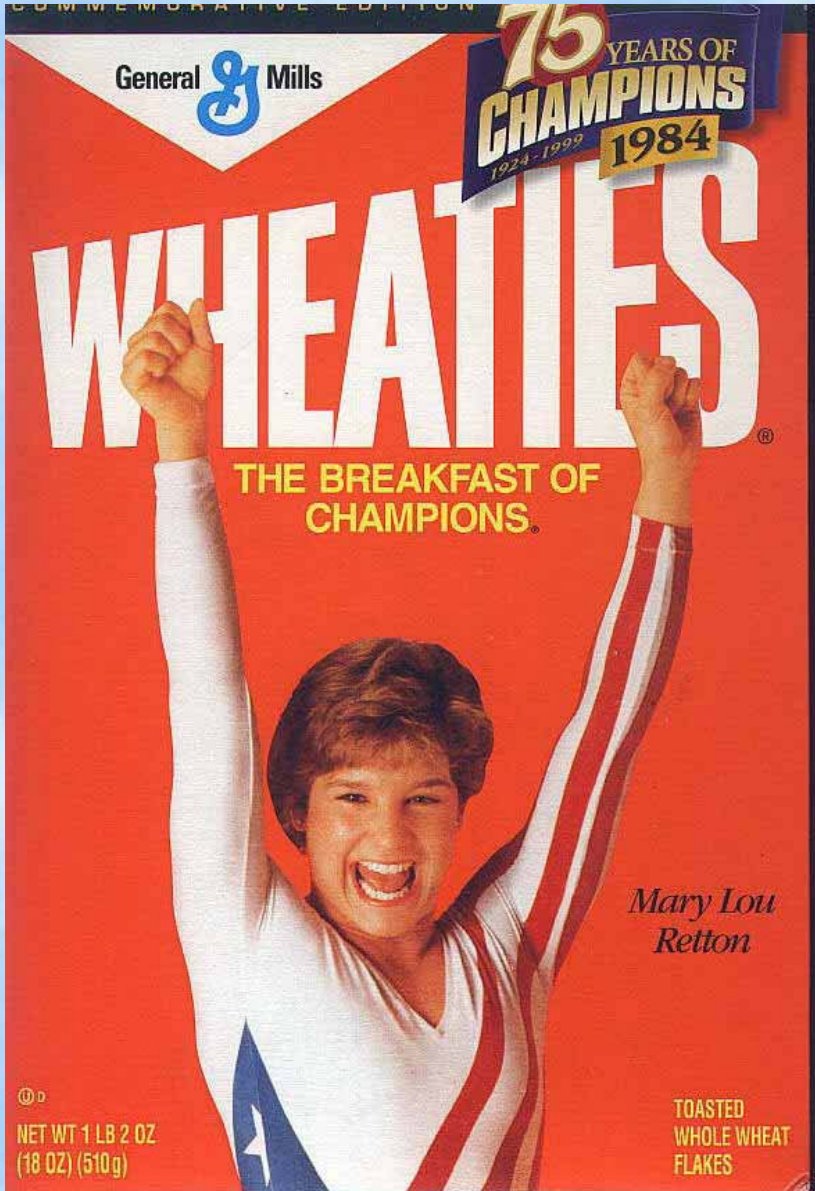


# CARPOOLING CAN SAVE MORE THAN GAS



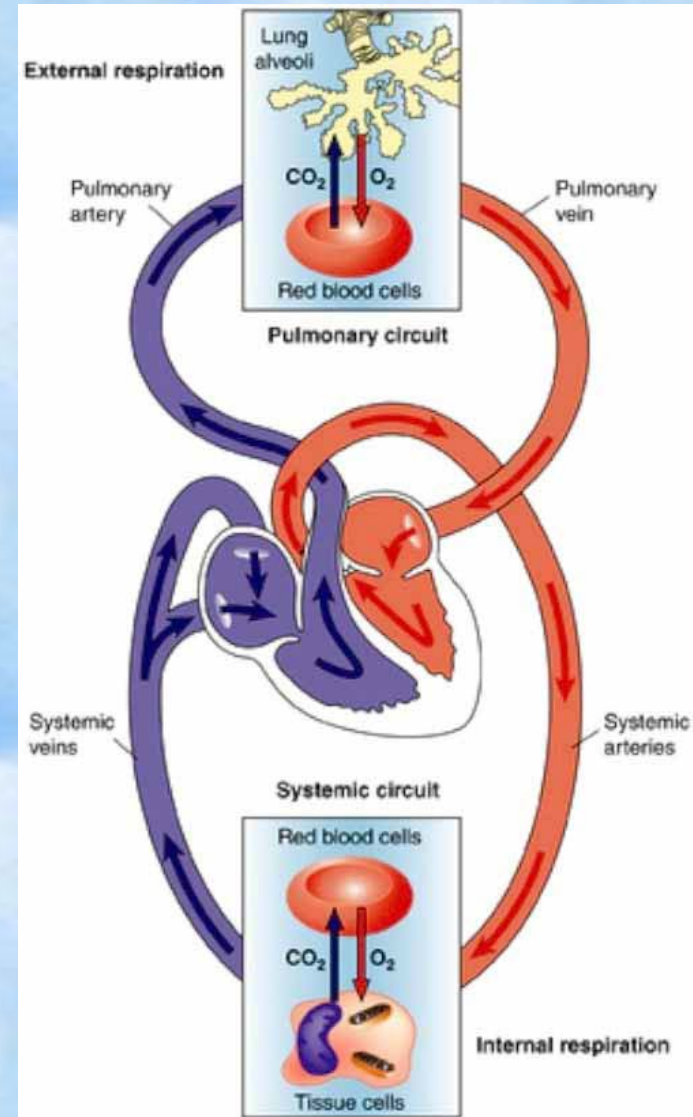
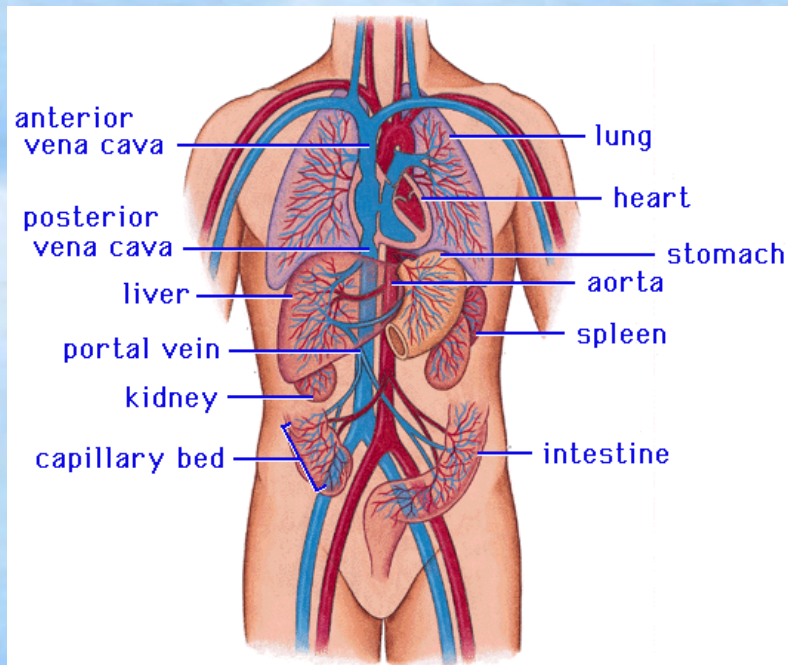
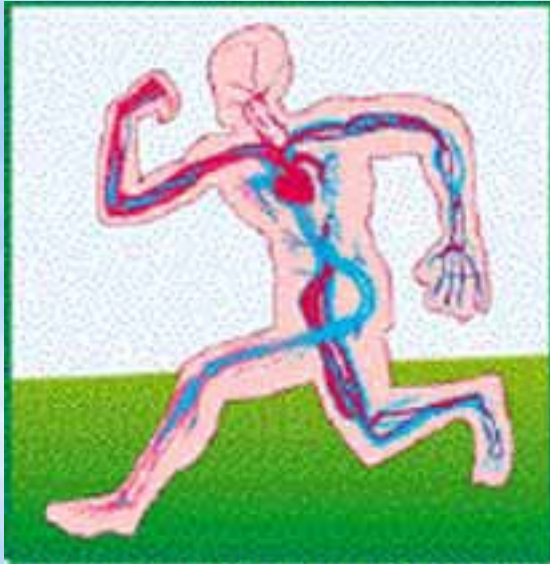


# WHERE DO YOU GET YOUR ENERGY?





# HOW DO ENERGY AND OXYGEN GET TO YOUR MUSCLES?



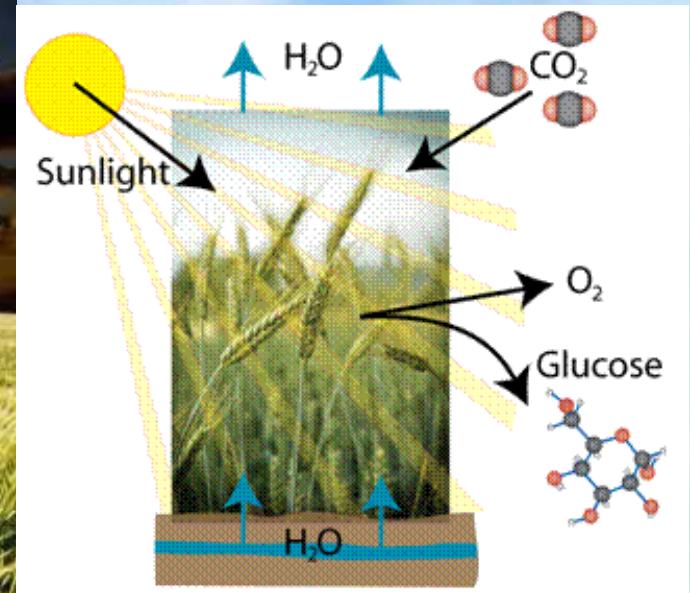
<http://www.prevent-stroke-and-heart-attack.com>

<http://library.thinkquest.org/5777/cir1.htm>

<http://newstt.com/how-is-circulatory-system-and-the-digestive-system-related/>



# WHERE DOES YOUR FOOD GET *ITS* ENERGY?



[www.ems.psu.edu/~pisupati/ACSO outreach/  
Petroleum\\_1.html](http://www.ems.psu.edu/~pisupati/ACSO outreach/Petroleum_1.html)

[www.desktopwallpaperhd.com](http://www.desktopwallpaperhd.com)

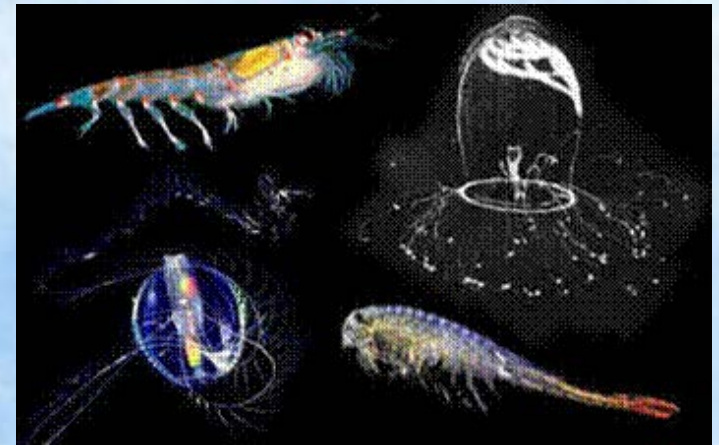
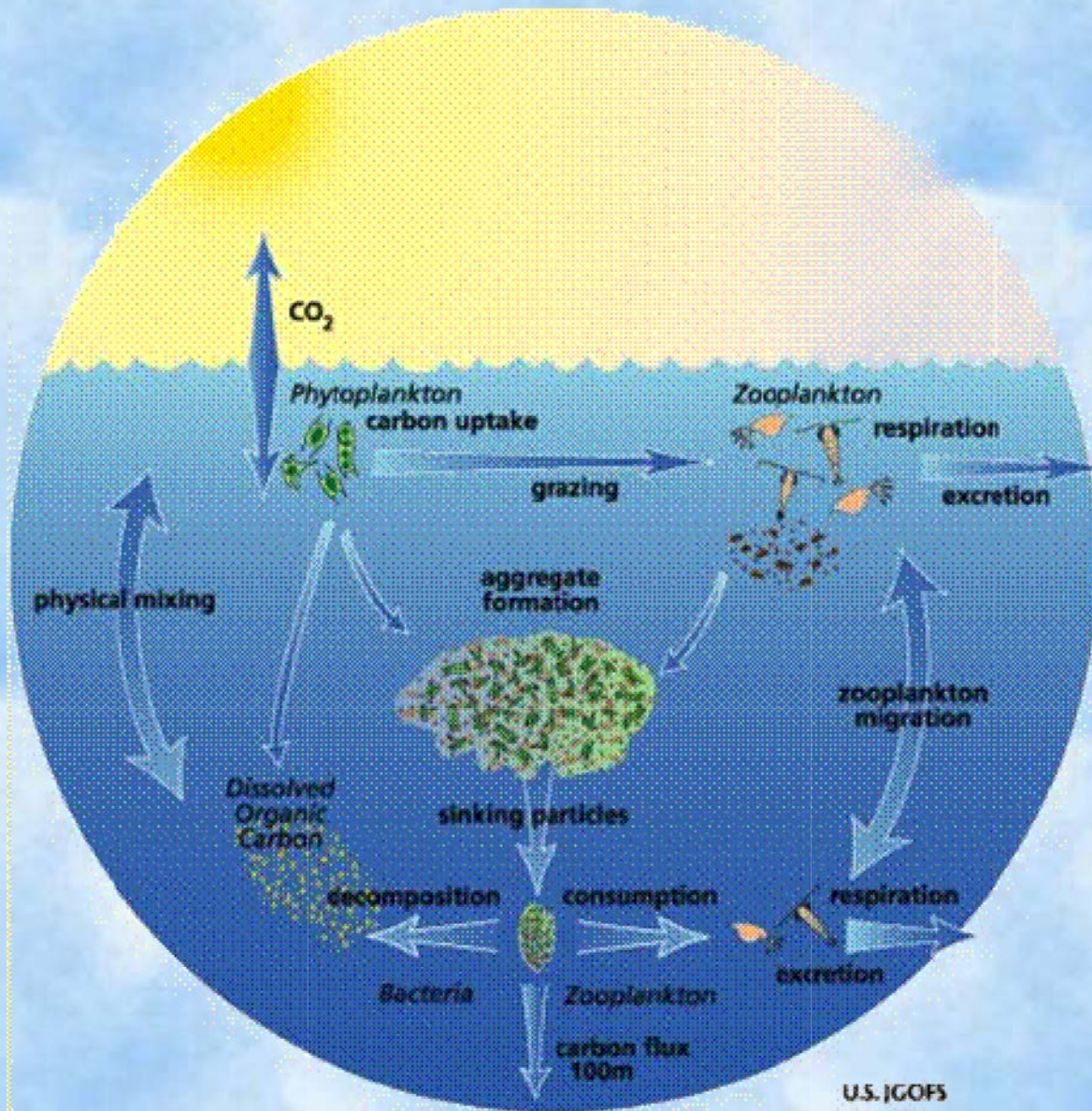


# WHERE DOES YOUR CAR GET *ITS* ENERGY?

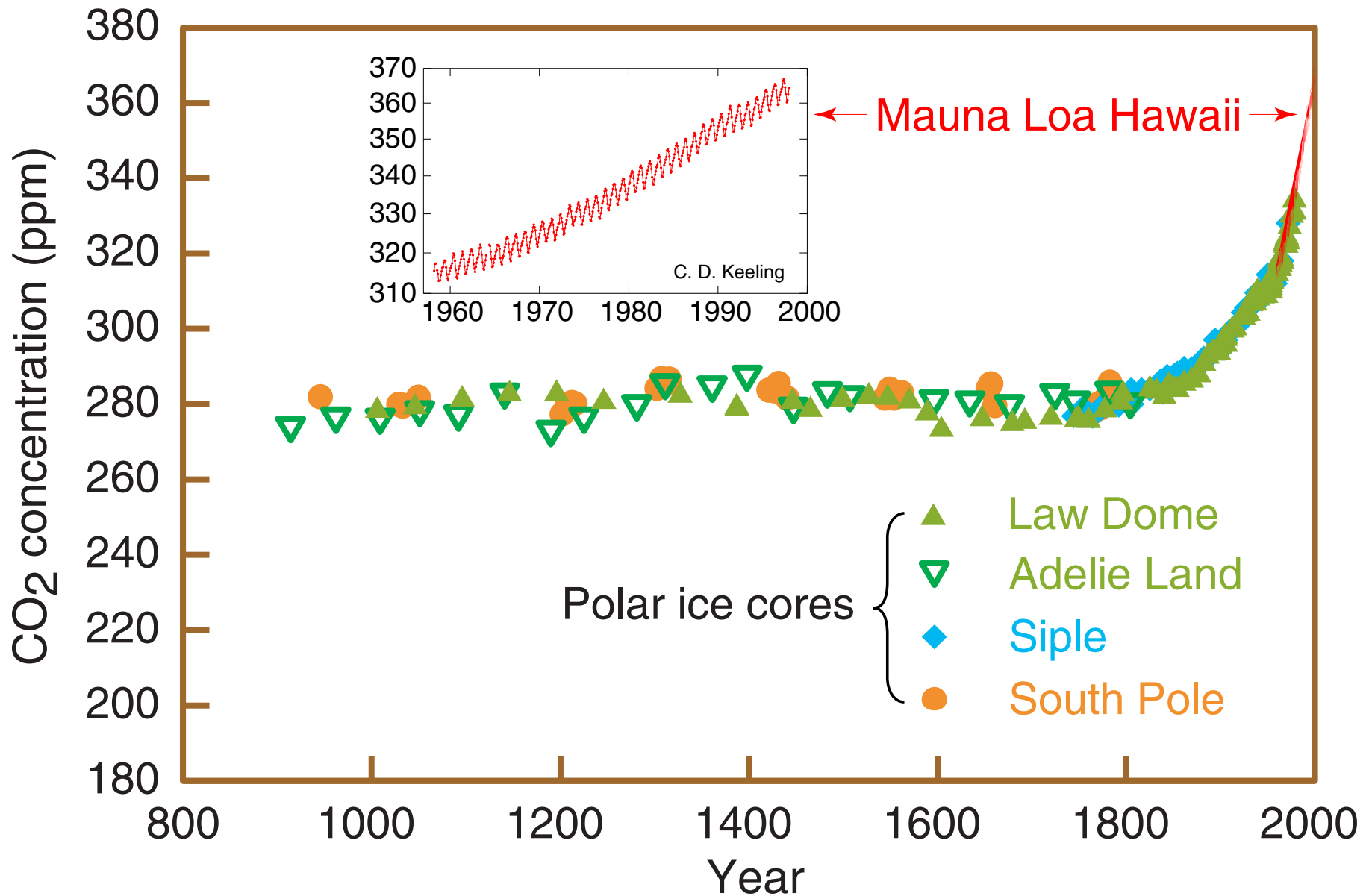




# WHERE DOES GASOLINE GET ITS ENERGY?



# ATMOSPHERIC CARBON DIOXIDE IS INCREASING



Global carbon dioxide concentration over the last thousand years



***WHERE IS ALL  
THIS CO<sub>2</sub>  
COMING FROM?***

***WHO IS  
RESPONSIBLE?***



# HOW MUCH CARBON IS IN A GALLON OF GASOLINE?



1 lb?

2 lbs?

3 lbs!?



5 lbs!?!?

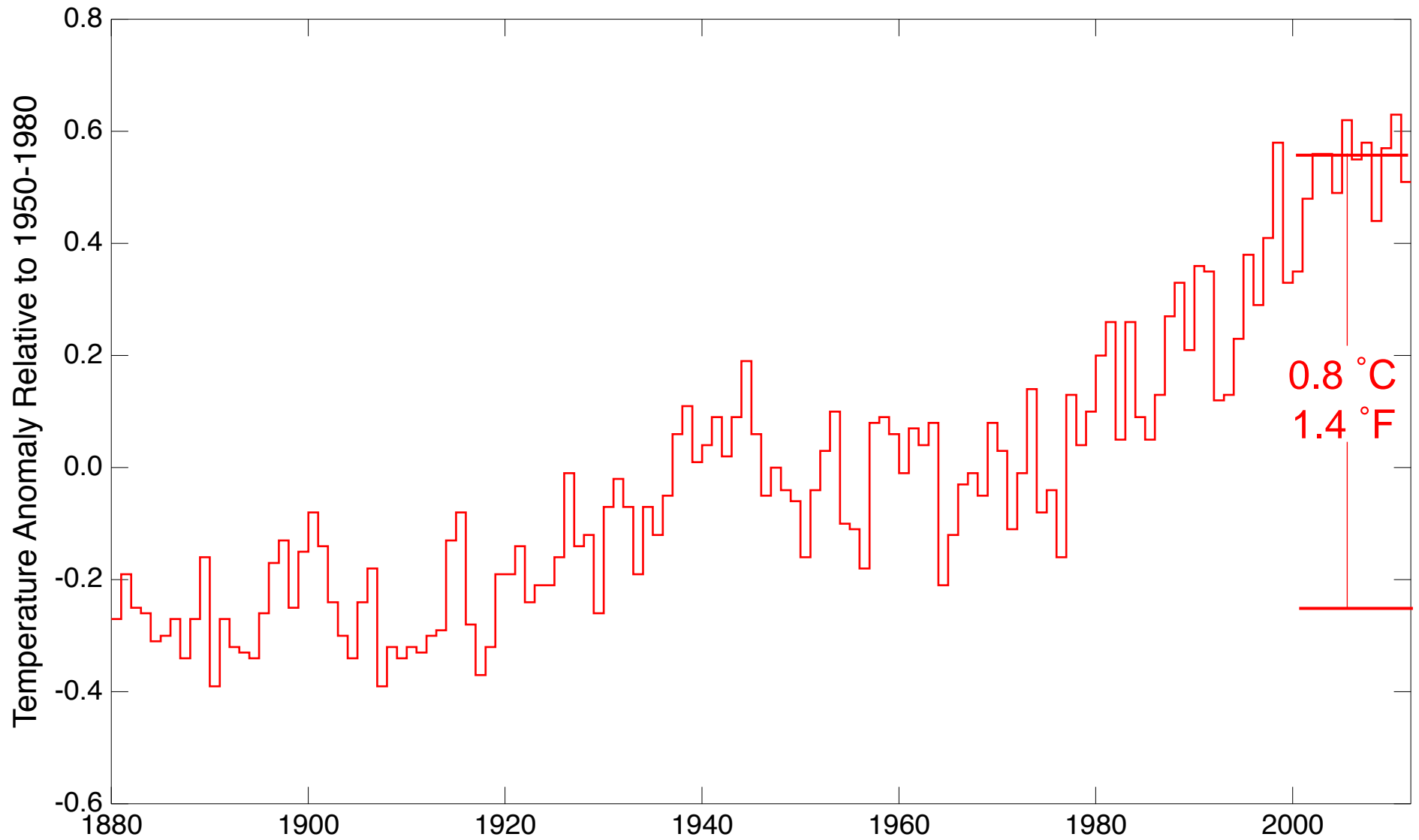


All of this carbon goes into the  
atmosphere as carbon dioxide when  
you burn the gasoline in your car.



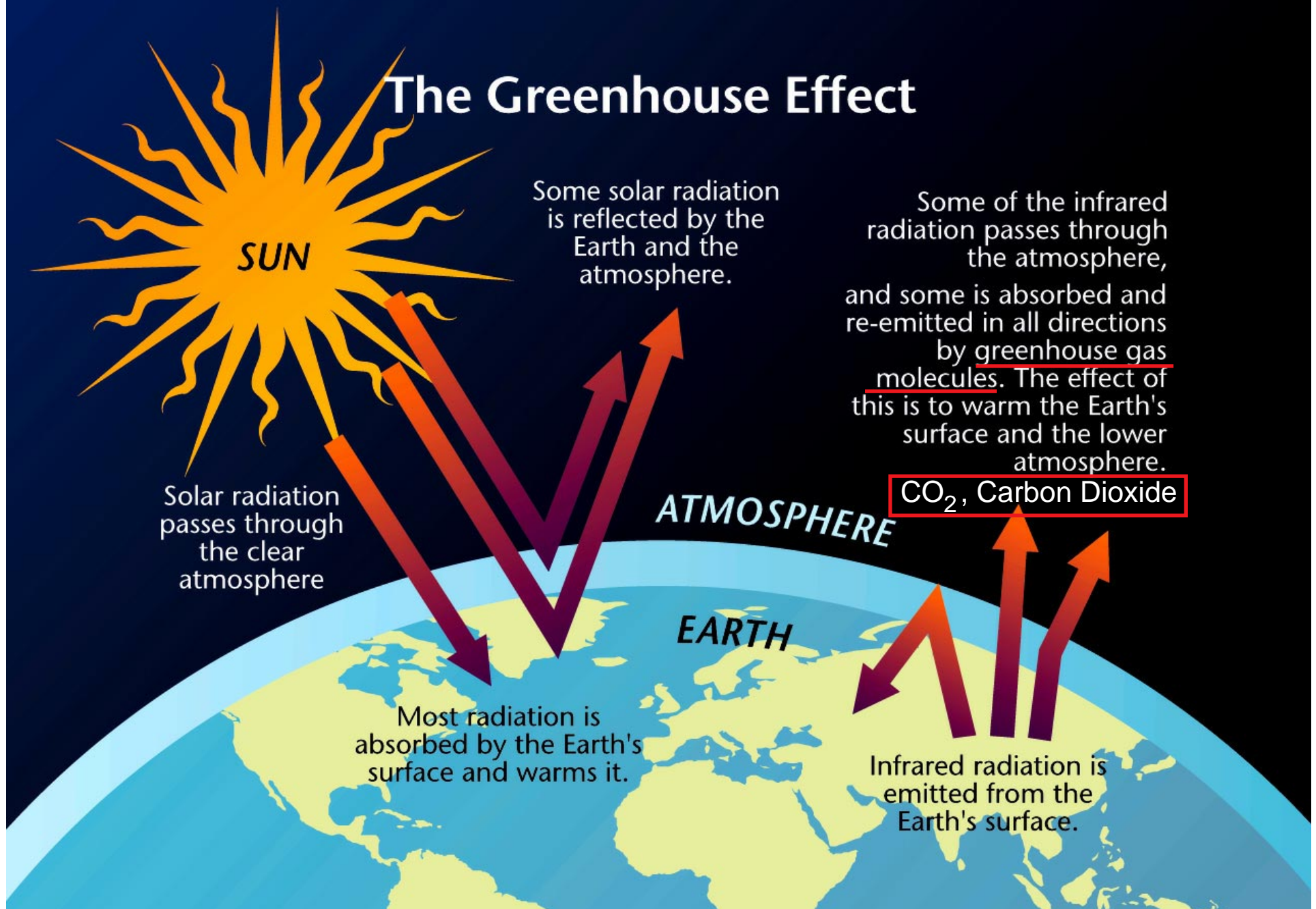


# GLOBAL TEMPERATURE OVER PAST 130 YEARS



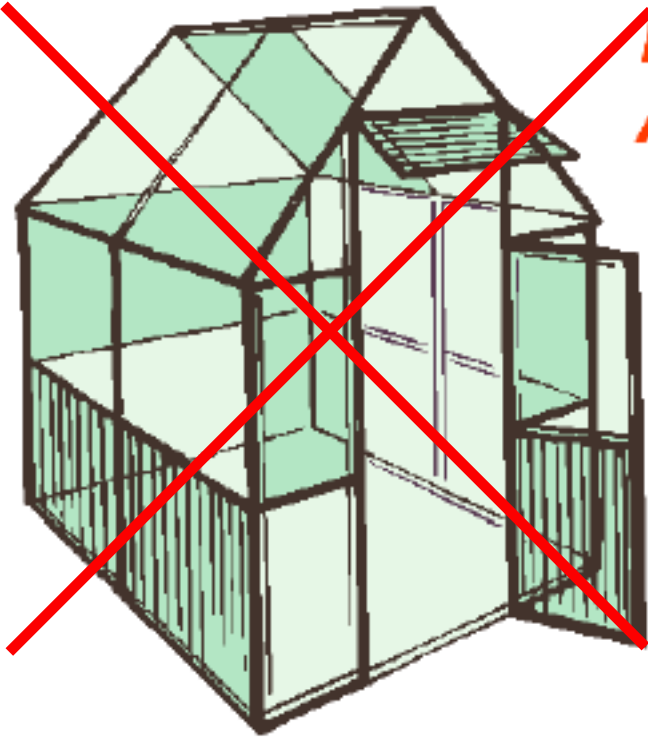
*NASA Goddard Institute for Space Studies*

# The Greenhouse Effect





# THE GREENHOUSE EFFECT



## ***EARTH'S ENERGY BUDGET: A DELICATE BALANCE***

- Sunlight heats the Earth.
- The warm Earth radiates energy (in the form of infrared radiation, or heat) back out to space.
- Some of this infrared radiation is trapped in the atmosphere, giving Earth its temperate climate.

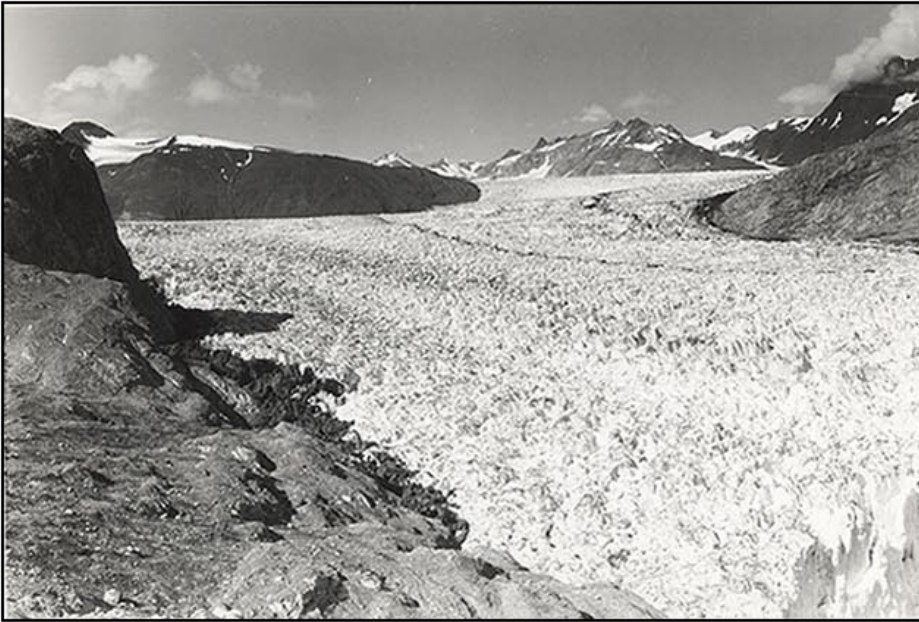
**This is the greenhouse effect.**

**Global average temperature 15°C or 59°F**

**Without it, the Earth's climate would be like the moon's, harsh and severe.**

**Global average temperature -19°C or -2 °F**

# MUIR GLACIER - MUIR INLET GLACIER BAY NATIONAL PARK, ALASKA 1941 vs. 2004



*Muir Glacier, William O. Field on 13 August 1941 and by Bruce F. Molnia on 31 August 2004*



# UPSALA GLACIER, ANDES, ARGENTINA

1928



2004



[www.time.com](http://www.time.com)

# RHONE GLACIER, VALAIS, SWITZERLAND

## 1859 - 2001



Glacial retreat is 2.5 km.

Base is 450 meters higher.

<http://www.worldviewofglobalwarming.org/pages/glaciers.html>



# STUDYING EARTH'S CLIMATE HISTORY

“A Climate Scientist Battles Time and Mortality”



*New York Times, July 2, 2012*

Lonnie Thompson, Ohio State University glaciologist, studies Earth's climate history by the ice archive.

The glaciers are melting, erasing our history.

# ARIZONA FIRES

Sierra Vista, Arizona, June, 2011



Third largest fire in Arizona history.



# ARIZONA FIRES

Monument Fire, Arizona, June, 2011



# MISSISSIPPI RIVER FLOOD

Vicksburg, Mississippi, May, 2011



Second highest flood on record; highest since 1937.



# MISSISSIPPI RIVER FLOOD

Morehouse, Missouri, May, 2011



# FLOODS IN NORTH DAKOTA

Souris River, Minot North Dakota, June 27, 2011



The river surpassed its 1881 record level of 1,558 feet above sea level, and flooded an estimated 4,000 homes in the city.



# TORNADO IN MISSOURI

Joplin, Missouri, May, 2011



Devastating EF5 multiple-vortex tornado that struck Joplin, Missouri, late in the afternoon of Sunday, May 22, 2011.

# TORNADO IN MASSACHUSETTS

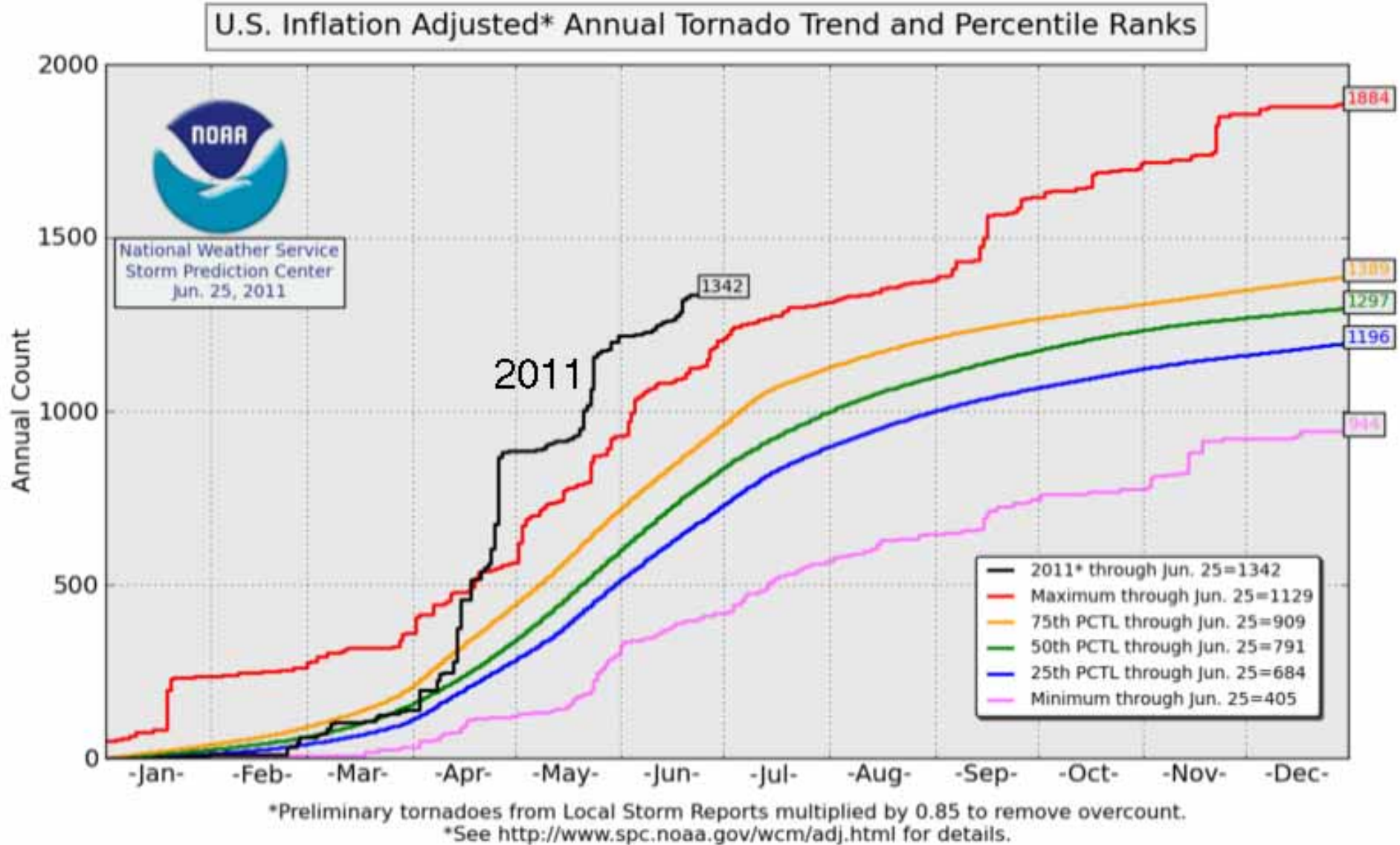
Springfield, Massachusetts, June, 2011



Seven tornadoes from Connecticut to Maine in rare New England outbreak.



# UNITED STATES TORNADO COUNT



1,140 confirmed tornadoes reported in the US in 2011 as of June 23, 2008.  
537 U. S. deaths, compared to 564 in the 10 years prior.

# FIRES, COLORADO SPRINGS

June 26, 2012



<http://www.pbs.org/newshour/multimedia/viewerfirephotos/index.html>



# FIRES, COLORADO SPRINGS

June, 2012



<http://news2image.blogspot.com/>

# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*El Dorado, Kan*



# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Ashley, Illinois*

“It really is a crisis,” said Gov. Pat Quinn of Illinois after touring ravaged farms in the southern part of the state. “I don’t think we’ve ever seen anything like this in my lifetime.”

# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*El Dorado, Kansas*

The government has declared one-third of the nation's counties — 1,297 of them across 29 states — federal disaster areas as a result of the drought.



# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Princeton, Indiana*

# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Bottom of Reservoir, Cicero, Indiana*



# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Indianapolis, Indiana*

# The New York Times

Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Mitchell Lake in the Ballard Wildlife Management Area near Barlow, Ky*



# The New York Times

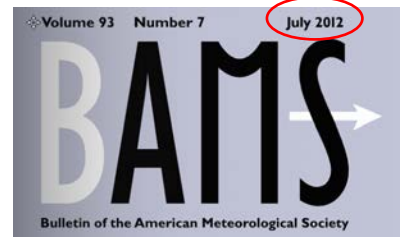
Friday, July 20, 2012

## Widespread Drought Is Likely to Worsen



*Platte River near Louisville, Nebraska*

# WEATHER *EXTREMES* OF 2011 IN CLIMATE PERSPECTIVE



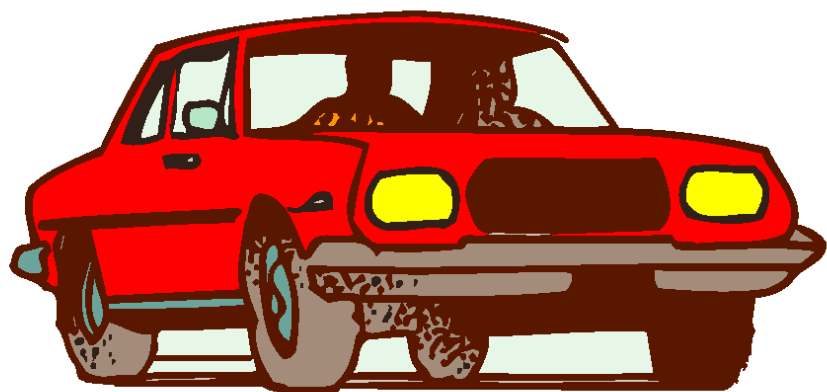
## DID HUMAN INFLUENCE ON CLIMATE MAKE THE 2011 TEXAS DROUGHT MORE PROBABLE?

- We found that extreme heat events were *roughly 20 times more likely in 2008* than in other La Niña years in the 1960s and indications of an *increase in frequency of low seasonal precipitation totals*.
- With 2008 serving as our proxy for 2011, this suggests that *conditions leading to droughts such as the one that occurred in Texas in 2011 are, at least in the case of temperature, distinctly more probable than they were 40–50 years ago*.



# ***WHERE IS THIS CARBON DIOXIDE COMING FROM?***

## ***WE ARE ALL RESPONSIBLE.***



Burning a gallon of gasoline in your car puts 5 pounds of carbon in the atmosphere as carbon dioxide ( $\text{CO}_2$ ), and it will stay there for decades — maybe a century!

Other sources are home heating and electric power production.



# ENERGY EFFICIENT CARS

Decrease your carbon legacy by driving an energy efficient car



Decrease your gasoline bill, and drive in HOV lane, too!



# SOLAR PHOTOVOLTAIC ENERGY

Decrease your carbon legacy by generating your own electricity



Decrease your electric bill, too; maybe even to zero!

# Global Atmosphere, Global Warming

## QUESTIONS ABOUT GLOBAL WARMING

- IS IT REAL?
- IS IT IMPORTANT?
- WHAT IS IT DUE TO?
- HOW MUCH MORE CAN WE EXPECT?
- ARE WE SEEING JUST THE TIP OF THE ICEBERG?



***RESEARCH IS HELPING  
TO ANSWER THESE QUESTIONS.***

***[www.ecd.bnl.gov/steve](http://www.ecd.bnl.gov/steve)***



# THANK YOU

summer  sundays

  
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